

X-ray imaging of magnetization reversal by spin-transfer

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We present the first images, to our knowledge, of magnetization reversal of nanopillars using the spin-transfer effect. The spin-transfer effect is the manipulation of a magnetic layer by way of a current which is spin-polarized by a fixed reference magnetic layer. A magnetic tri-layer of CoFe/Cu/CoFe is patterned with electron beam lithography on a silicon nitride membrane. A current pulse running through the nanopillar excites dynamics which are probed by x-rays. The energy and circular polarization of the x-rays is controllable and provides the sensitivity to magnetization by way of the x-ray magnetic circular dichroism (XMCD). The temporal and spatial resolution, as well as the layer specificity of this technique offers the ability to elucidate many aspects of the spin-transfer effect. We show results on measurements of varying size ellipses of a CoFe/Cu/CoFe magnetic trilayer. Oersted fields are shown to have a strong influence on the magnetization and we see directly the limitations of the macrospin approximation. It is seen that the magnetic shape anisotropy plays an important role in the final relaxation of the magnetization to a uniform state.